SDMS US EPA Region V

Imagery Insert Form

Document ID: 226791

Some images in this document may be illegible or unavailable in SDMS. Please see reason(s) indicated below:

EPA Region 5 Records Ctr.

226791

[X] Illegible due to bad source documents. Image(s) in SDMS is equivalent to hard copy.

Specify Type of Document(s) / Comments:

FIGURES 2 THROUGH 5 GRAPHS

[ ] Includes ____ COLOR or ____ RESOLUTION variations.
Unless otherwise noted, these pages are available in monochrome. The source document page(s) is more legible than the images. The original document is available for viewing at the Superfund Records Center.

Specify Type of Document(s) / Comments:

[ ] Confidential Business Information (CBI).
This document contains highly sensitive information. Due to confidentiality, materials with such information are not available in SDMS. You may contact the EPA Superfund Records Manager if you wish to view this document.

Specify Type of Document(s) / Comments:

[ ] Unscannable Material:
Oversized ____ or ____ Format.
Due to certain scanning equipment capability limitations, the document page(s) is not available in SDMS. The original document is available for viewing at the Superfund Records center.

Specify Type of Document(s) / Comments:

[ ] Document is available at the EPA Region 5 Records Center.

Specify Type of Document(s) / Comments:

STS CONSULTANTS, LTD.
Consulting Engineers and Environmental Scientists
750 Corporate Woods Parkway
Vernon Hills, Illinois 60061
Phone: (847) 279-2500
Fax: (847) 279-2510

Date: January 10, 2003
Total Number of Pages, Including Cover: 16

FAX TRANSMITTAL COVER SHEET

PLEASE DELIVER THE FOLLOWING PAGES

NAME: Verneta Simon, Fred Micke, Mary Fulghum
David Carlins, Kara Hughes

COMPANY: USEPA
Lakeshore East LLC

FAX NUMBER(S): 312-353-9176
312-642-2773

FROM: Rich Berggreen

MESSAGE: Attached please find our letter and attachments in response to USEPA correspondence of January 7, 2003 regarding the down-hole investigation for radiological impacts at Lakeshore East. The revisions have been discussed with Larry Jensen; however, he has not had time to review the revisions to the attached calculation spreadsheets. Please call with any comments.

IF YOU DO NOT RECEIVE ALL PAGES, PLEASE CALL (847) 279-2500 IMEDIATELY

STS USE ONLY:	OFFICE	DEPT	JOB/PROJECT	NO.
	TASK NO.			

STS CONSULTANTS

STS Consultants, Ltd.
750 Corporate Woods Parkway
Vernon Hills, Illinois 60061-3153
voice 847-279-2500
fax 847-279-2510
web www.stsconsultants.com

January 10, 2003

Ms. Verneta Simon, On-Scene Coordinator
Mr. Fred Micke, On-Scene Coordinator
US Environmental Protection Agency
Region 5
77 W. Jackson Blvd., SE-5J
Chicago, Illinois 60604

RE: Investigation of Radiological Impacts Below Groundwater, Lakeshore East Site, 221 N. Columbus Drive, Chicago, Illinois - STS Project No. 1-32193-XC

Dear Ms. Simon and Mr. Micke:

This letter and the attached information are in response to your correspondence dated January 7, 2003 regarding the above-referenced project. We have reviewed the memorandum dated January 6, 2003 from Mr. Larry Jensen provided with your letter and have the following comments and recommended revisions.

The item of most significance appears to be the revision in the gamma count threshold to be used as indicative of an exceedance of the cleanup threshold. The background in developing the adjustment factors and the calculations provided by Mr. Jensen were extremely useful. We have used the interpreted factors and spreadsheets developed by Mr. Jensen.

One revision to the calculation is in the "thickness of water absorber" factor "x". In our correspondence to you dated November 6, 2002 presenting the topic of this material below groundwater, we described the down-hole gamma measurements as having been taken inside a 3-inch casing that was placed inside a 6-inch diameter boring. This provides a 1.5-inch annular space between the casing and the wall of the bore hole. We note that in the calculation performed by Mr. Jensen, he used a 3-inch thickness of water absorber factor. We have recalculated the equation throughout to change the factor "x" to 1.5 inches (3.81 cm).

Additionally, review of the equations and calculations noted an input error on Tables 10 through 17, where a factor was entered as "0" and should have been "1". When this correction was made, the adjusted count equivalent to 7.1 pCi/g was found to be 5,054 counts per 30 seconds.

We note in Mr. Jensen's memorandum that he was directed to make "worst case" assumptions. This may have been interpreted to assume the casing was pressed against one side of the bore hole resulting in there being 3 inches of annular space and water on the other side. However, this assumption would also require that the radioactive material be solely limited to the portion of the borehole wall opposite the casing, requiring any detected gamma radiation to pass through the intervening 3 inches of water, with no radiation coming from the wall against which the casing was in contact. While this may be a worst case, it does not appear to be reasonable.

We also request that the cleanup threshold used at the site be agreed to as follows. The total radium value that is the cleanup threshold is background (2.1 pCi/g) plus 5 pCi/g. Anything over this, i.e., 7.2 pCi/g, is an exceedance of the threshold. Our calibration is meant to determine the readings in gamma counts that represent 7.2 pCi/g. Therefore, our value of 5,396 counts per 30 seconds is a valid threshold for determining the presence of material equal to or exceeding the 7.2 pCi/g total radium criterion. The adjustment for this factor is rather small, (7.2/7.1 = 1.014) and raises the threshold to 5,126 counts per 30 seconds.

In considering these two adjustments to the down-hole gamma survey, we represent that the adjusted cleanup threshold considering the presence of water in the annular space around the steel casing used in the down-hole survey is 5,126 counts per 30 seconds. With this adjusted threshold, none of the down-hole gamma readings are in excess of the threshold.

We request your written concurrence with this information, and that no further exploration or remediation is required at this location.

Please contact us with any questions you may have regarding the attached information.

Regards,

STS CONSULTANTS, LTS.

Richard G. Berggreen, C.P.G.
Principal Geologist

cc: Mary Fulghum, USEPA
David Carlin, Kara Hughes, Lakeshore East Development, LLC

Attachment: Revised Attachments from Mr. Larry Jensen Memorandum dated January 6, 2003

Table 1: Thorium Gamma Emission Energies and Yields

Radio-nuclide	Emission Energies (keV)	Yield (unitless)
Pb-212	238.6	0.446
Ac-228	338.4	0.120
Tl-208	510.8	0.216
Tl-208	583.1	0.858
Tl-208	860.4	0.120
Ac-228	911.1	0.290
Ac-228	968.9	0.175
Tl-208	2615	0.998

From: Publication 38
International Commission on Radiological Protection
"Radionuclide Transformations, Energy and Intensity of Emissions"

Table 2: Mass Attenuation Coefficients

Emission Energy (keV)	Mass Attenuation Coefficient (cm^2/g)
100	0.171
150	0.151
200	0.137
300	0.119
400	0.106
500	0.0968
600	0.0896
800	0.0786
1000	0.0707
1500	0.0575
2000	0.0494
3000	0.0397
4000	0.0340

From: Radiological Health Handbook

Figure 1: Mass Attenuation Coefficients versus Gamma Emission Energy

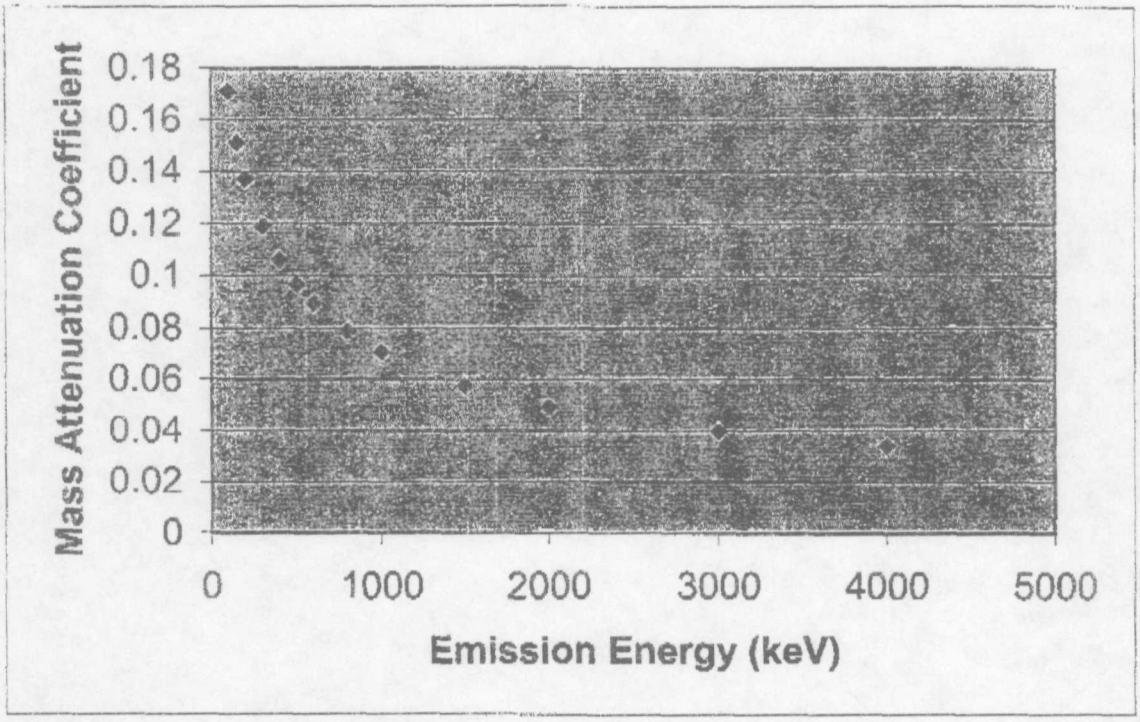

Table 3: Least Squares Fit for Mass Attenuation Coefficient

Energy Range for Least Squares Fit (keV)	Least Squares Fit				Emission Energy (keV)		Mass Attenuation Coefficient (cm2/g)	Mean Mass Attenuation Coefficient (cm2/g)
	a	+	b	*		=		
150 - 300	0.181	+	-2.086E-04	*	238.6	=	0.131	0.131
200 - 400	0.167	+	-1.550E-04	*	238.6	=	0.130	
200 - 400	0.167	+	-1.550E-04	*	338.4	=	0.115	0.114
300 - 500	0.152	+	-1.110E-04	*	338.4	=	0.114	
400 - 600	0.152	+	-1.110E-04	*	510.8	=	0.095	0.095
500 - 800	0.126	+	-5.986E-05	*	510.8	=	0.095	
400 - 600	0.138	+	-8.200E-05	*	583.1	=	0.090	0.091
500 - 800	0.126	+	-5.986E-05	*	583.1	=	0.091	
600 - 1000	0.117	+	-4.725E-05	*	860.4	=	0.076	0.076
800 - 1500	0.101	+	-2.942E-05	*	860.4	=	0.076	
600 - 1000	0.117	+	-4.725E-05	*	911.1	=	0.074	0.074
800 - 1500	0.101	+	-2.942E-05	*	911.1	=	0.074	
600 - 1000	0.117	+	-4.725E-05	*	968.9	=	0.071	0.072
800 - 1500	0.101	+	-2.942E-05	*	968.9	=	0.072	
1500 - 3000	0.07391	+	-1.156E-05	*	2615	=	0.044	0.044
2000 - 4000	0.06413	+	-7.70E-06	*	2615		0.044	

Table 4: Mass Attenuation Coefficient by 2 Point Interpolation and Comparison to Mean Mass Attenuation Coefficient by Least Squares Fit

Energy (keV)	Mass Attenuation Coefficient--- By 2 Point Interpolation (cm2/g)	Mean Mass Attenuation Coefficient---By Least Squares Fit (cm2/g)
200	0.137	
238.6	**0.130**	0.131
300	0.119	
300	0.119	
338.4	**0.114**	0.114
400	0.106	
500	0.0968	
510.8	**0.0960**	0.0954
600	0.0896	
500	0.0968	
583.1	**0.0908**	0.0906
600	0.0896	
800	0.0786	
860.4	**0.0762**	0.0760
1000	0.0707	
800	0.0786	
911.1	**0.0742**	0.0741
1000	0.0707	
800	0.0786	
968.9	**0.0719**	0.0719
1000	0.0707	
2000	0.0494	
2615	**0.0434**	0.0438
3000	0.0397	

Table 5: Linear Absorption Coefficient and Buildup Factor For 500 keV

Emission Energy (keV)	ux	B
500	1	2.63
	2	4.29
	4	9.05
	7	20.0
	10	35.9

Figure 2: Linear Absorption Coefficient versus Buildup Factor for 500 keV

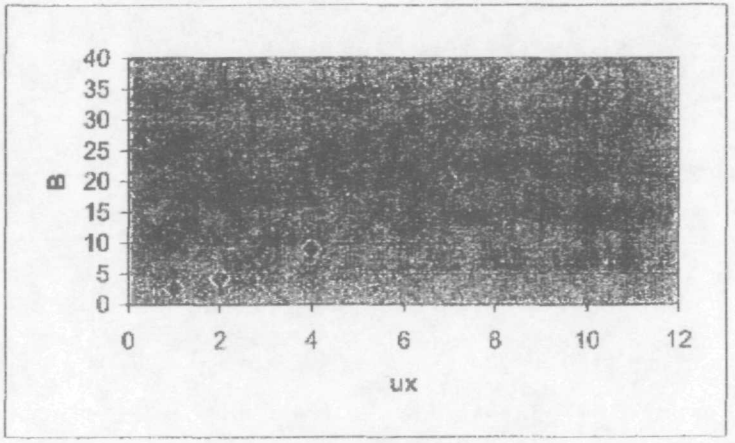

Table 6: Linear Absorption Coefficient and Buildup Factor For 1000 keV

Emission Energy (keV)	ux	B
1000	1	2.26
	2	3.39
	4	6.27
	7	11.5
	10	18.0

Figure 3: Linear Absorption Coefficient versus Buildup Factor for 1000 keV

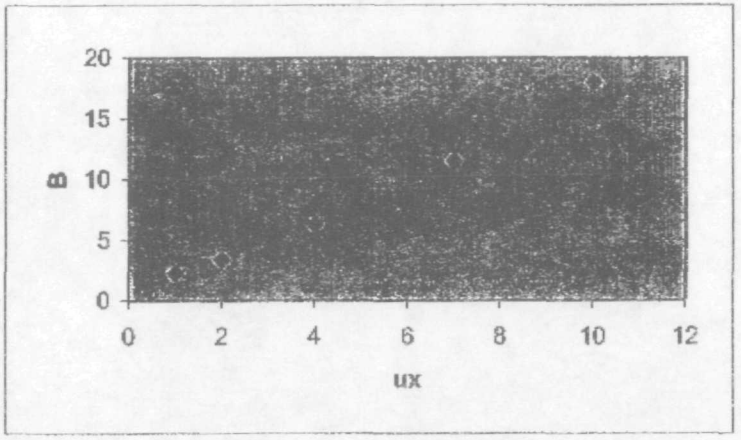

Table 7: Linear Absorption Coefficient and Buildup Factor For 2000 keV

Emission Energy (keV)	ux	B
2000	1	1.84
	2	2.63
	4	4.28
	7	6.96
	10	9.87

Figure 4: Linear Absorption Coefficient versus Buildup Factor for 2000 keV

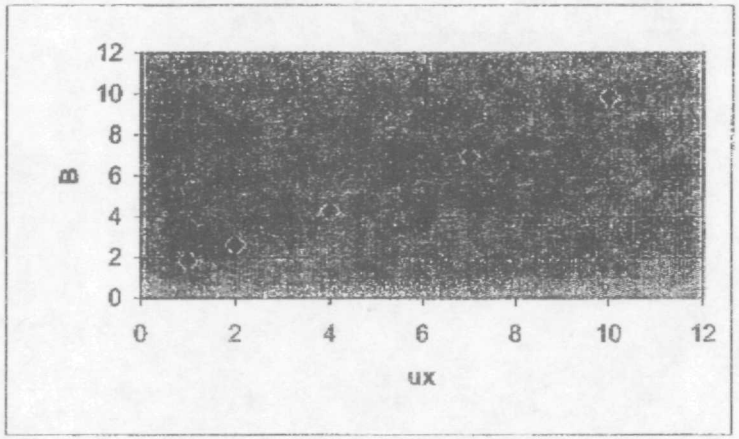

Table 8: Linear Absorption Coefficient and Buildup Factor For 3000 keV

Emission Energy (keV)	ux	B
3000	1	1.69
	2	2.31
	4	3.57
	7	5.51
	10	7.48

Figure 5: Linear Absorption Coefficient versus Buildup Factor for 3000 keV

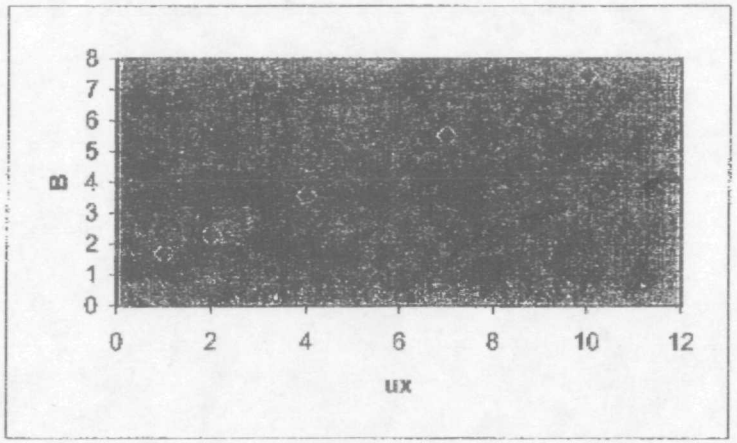

Table 9: Interpolated Plane Monodirectional Source Buildup Factor

Emission Energy (MeV)	Mean Emission Energy Mass Absorption Coefficient (u/p) (cm2/g)	Mean Emission Energy Linear Absorption Coefficient (ux) (unitless)	Interpolated Plane Source Buildup Factor (b) (unitless)
238.6	0.130	0.49550	0.86
338.4	0.114	0.43437	1.16
510.8	0.0960	0.36585	1.59
583.1	0.0908	0.34601	1.54
860.4	0.0762	0.29038	1.40
911.1	0.0742	0.28275	1.38
968.9	0.0719	0.27405	1.35
2615	0.0434	0.16549	1.13

ux = u/p * x * p

where

x = 3 inches = 7.62 cm

p = 1 g / cm3 = 1 g / cm3

Buildup Factor Interpolations

Buildup Factor Interpolations

Table 10: Buildup Factor Interpolations for 238.6 keV

	0	0.49550	1	2	a +	b *	ux	=		
0	0	0	0.00	0						
238.6	1	0.86								
500	1	1.81	2.63	4.29	0.995	1.64	0.49550	=	1.81	By Least Squares
					0	0.003615	238.6	=	0.86	By 2 points

Table 11: Buildup Factor Interpolations for 338.4 keV

	0	0.43437	1	2	a +	b *	ux	=		
0	0	0.00	0	0						
338.4	1	1.16								
500	1	1.71	2.63	4.29	0.995	1.64	0.43437	=	1.71	By Least Squares
					0	0.003415	338.4	=	1.16	By 2 points

Table 12: Buildup Factor Interpolations for 510.8 keV

	0	0.36585	1	2	a +	b *	ux	=		
500	1	1.59	2.63	4.29	0.995	1.64	0.36585	=	1.59	By Least Squares
510.8	1	1.59								
1000	1	1.46	2.26	3.39	1.02	1.20	0.36585	=	1.46	By Least Squares
					1.7309583	-0.000272	510.8	=	1.59	By 2 points

Table 13: Buildup Factor Interpolations for 583.1 keV

	0	0.34601	1	2	a +	b *	ux	=		
500	1	**1.56**	2.63	4.29	0.995	1.64	0.34601	=	1.56	By Least Squares
583.1	1	**1.54**								
1000	1	**1.44**	2.26	3.39	1.02	1.20	0.34601	=	1.44	By Least Squares
					1.689705	-0.000254	583.1	=	1.54	By 2 points

Table 14: Buildup Factor Interpolations for 860.4 keV

	0	0.29038	1	2	a +	b *	ux	=		
500	1	**1.47**	2.63	4.29	0.995	1.64	0.29038	=	1.47	By Least Squares
860.4	1	**1.40**								
1000	1	**1.37**	2.26	3.39	1.02	1.20	0.29038	=	1.37	By Least Squares
					1.5739823	-0.000206	860.4	=	1.40	By 2 points

Table 15: Buildup Factor Interpolations for 911.1 keV

	0	0.28275	1	2	a +	b *	ux	=		
500	1	**1.46**	2.63	4.29	0.995	1.64	0.28275	=	1.46	By Least Squares
911.1	1	**1.38**								
1000	1	**1.36**	2.26	3.39	1.02	1.20	0.28275	=	1.36	By Least Squares
					1.5581117	-0.000199	911.1	=	1.38	By 2 points

Table 16: Buildup Factor Interpolations for 968.9 keV

	0	0.27405	1	2	a +	b *	ux	=		
500	1	1.44	2.63	4.29	0.995	1.64	0.27405	=	1.44	By Least Squares
968.9	1	1.35								
1000	1	1.35	2.26	3.39	1.02	1.20	0.27405	=	1.35	By Least Squares
					1.5400186	-0.000191	968.9	=	1.35	By 2 points

Table 17: Buildup Factor Interpolations for 2615 keV

	0	*0.16549*	*1*	*2*	a +	b *	ux	=		
2000	1	1.14	1.84	2.63	1.01	0.815	0.16549	=	1.14	By Least Squares
2615	1	1.13								
3000	1	1.12	1.69	2.31	1.01	0.655	0.16549	=	1.12	By Least Squares
					1.197826	-0.000026	2615	=	1.13	By 2 points

Table 18: Ratio of Adjusted to Original Count Rate

Emission Energies	Interpolated Plane Source Buildup Factor	Emission Energy Mass Absorption Coefficient	Thickness of Water Absorber	Density of Water	Yield	Ratio, Absorbed Exposure Rate
	(b)	(u/p)	(x)	(p)		
(keV)	(unitless)	(MeV)	(cm)	(g/cm3)	(unitless)	(unitless)
238.6	0.86	0.130	3.81	1	0.446	0.53
338.4	1.16	0.114	3.81	1	0.120	0.75
510.8	1.59	0.0960	3.81	1	0.216	1.10
583.1	1.54	0.0908	3.81	1	0.858	1.09
860.4	1.40	0.0762	3.81	1	0.120	1.05
911.1	1.38	0.0742	3.81	1	0.290	1.04
968.9	1.35	0.0719	3.81	1	0.175	1.03
2615	1.13	0.0434	3.81	1	0.998	0.96
					3.22	7.54

Ratio = X / Xo = B exp(-[u/p] * x * p)

Total counts at 7.2 pCi/g 5396 counts / 30 seconds
Total counts at 7.1 pCi/g 5321

5321 / 3.22 1652

Table 19: Adjusted Count Rate for Cleanup Criterion

A	B	C	D	E	F
Emission Energy (keV)	Yield (unitless)	1652 * Yield (unitless)	Ratio, Absorbed Exposure Rate (unitless)	Column C * Column D (unitless)	Column E / Column C
238.6	0.446	737	0.53	387	
338.4	0.120	198	0.75	148	
510.8	0.216	357	1.10	394	
583.1	0.858	1417	1.09	1546	
860.4	0.120	198	1.05	207	
911.1	0.290	479	1.04	497	
968.9	0.175	289	1.03	298	
2615	0.998	1649	0.96	1577	
	Total	5324	Total	5054	95%

Count rate equivalent to 7.1 pCi/g	=	5054 counts per 30 seconds